



#7/29/03
29/03
Sherri

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to:
Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450
on June 25, 2003

Sherri Sitzmann
(name of person making deposit)
Sherri Sitz
(signature)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:)	Attorney Docket No:
Anthony P. Peirce, et al.)	56.0468
)	
Serial No.: 09/301,961)	Group Art Unit: 2123
)	
Filed: April 4, 1999)	Examiner: Day, Herng-Der
)	
For: Method and Apparatus for Hydraulic)	
Fracturing Analysis and Design)	

AFFIDAVIT UNDER 37 CFR 1.132

Commissioner of Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Eduard Siebrits, being duly sworn, does hereby depose and say as follows:

I am one of the co-inventors of the above-identified patent application.

I received and hold a Bachelor of Science Degree in Civil Engineering from the University of Cape Town, South Africa in 1984; and I received a Masters of Science Degree in Civil Engineering from the University Cape Town, South Africa in 1987, with a thesis entitled "Three-Dimensional Elastodynamic Shear Fracture Propagation and Ground Motion Simulation Model". I received the degree of Doctor of Philosophy in Geo Engineering from the University of Minnesota, Minneapolis in 1992, with a thesis on "Two-Dimensional Time Domain Elastodynamic Displacement Discontinuity Method with Mining Applications";

I was employed from 1987 to 1995 by COMRO Rock Engineering, Johannesburg and CSIR Mining Technology, Johannesburg, working on 2D and 3D numerical modeling of rockburst processes in deep gold mines, including back analysis of a rockburst accident, developing numerical models based on boundary element, finite element, and finite difference methods;

I have been employed since 1995 by the Dowell Division of Dowell Schlumberger Inc, that later merged with Schlumberger Technology Corporation; working on 2D fluid flow models, 2D and planar 3D hydraulic fracturing simulators, refracture reorientation in tight gas wells, and comparisons of commercially available planar 3D simulators in the petroleum industry;

I have contributed to more than 20 publications, as shown by the attached list.

I am presently employed by Schlumberger Technology Corporation, the assignee of the above-identified application, in Sugar Land, Texas and currently the Team Leader of the Modeling & Mechanics Group of the Well Services division;

I am personally well familiar with the Grid Oriented Hydraulic Fracture Extension Replicator simulator (GOHFER), and with the content of the Doctor of Philosophy thesis written by R. Barree, as the basis of that work. R. Barree has always maintained that his model is applicable to a multi-layered reservoir and therefore should not require additional approaches such as the use of Fourier transforms as proposed by the patent application 09/301,961. Anthony Pierce and I have however concluded that this statement is wrong and that Barree's model relies on a postulate that implies uniform elastic properties for the whole reservoir, and consequently, is not physically or mathematically sound for a multi-layered reservoir.

I am also well familiar with the work of A. M. Linkov, A.A. Linkova and A.A. Savitski published in the article entitled "An Effective Method for Multi-Layered Media with Cracks and Cavities." In 1997, I approached A. A. Savitski for a potential collaboration but he advised me that the approach reported in their paper was not applicable for the case of cavities or cracks intersecting the interfaces in a multi-layered medium. As shown in figures 4 and 12 of the current patent application, a fracture in a subterranean formation typically intersects multiple layer boundaries. Therefore, Anthony Pierce and I concluded that we could not simply use this approach to overcome the deficiencies of the GOHFER model and we had to develop a new

model, based on the approach suggested by Linkov but modified to make it provide a model of fracture development applicable to a multi-layered formation.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.



Eduard Siebrits

Sworn and subscribed before me
this 25th day of June, 2003



Sherri Sitzmann
Notary Public



Siebrits, E. 2003. "On the boundary element method in solid mechanics," Schlumberger Applied Mathematics Work Group seminar, Houston, June 4, 2003.

Siebrits, E. 2001. "Refracture reorientation to enhance production," Schlumberger 'Hydraulic Fracturing Solutions Forum,' Houston, May 7-9, 2001.

Siebrits, E., Elbel, J.L., Hoover, R.S., Diyashev, I.R., Griffin, L.G., Demetrius, S.L., Wright, C.A., Davidson, B.M., Steinsberger, N.P. and Hill, D.G. 2001. "Refracture reorientation enhances gas production in Barnett shale tight gas wells," 48th Southwestern Petroleum Short Course (SWPSC), Lubbock, April 23-26.

Siebrits, E., Gu, H. and Desroches, J. 2001. "An improved pseudo-3D hydraulic fracturing simulator for multiple layered materials." proc: 10th International Conference on Computer Methods and Advances in Geomechanics (IACMAG), Tucson, Jan. 7-12, in: Computer Methods and Advances in Geomechanics (eds: Desai et al.), Balkema, Rotterdam, 1341-45.

Siebrits, E. and Peirce, A.P. 2000. "Hydraulic fracturing in laminated reservoirs." proc: Workshop on Hydraulic Fracturing, in conjunction with the Fourth North American Rock Mechanics Symposium (NARMS), Seattle, Jul. 29.

Birgisson, B., Siebrits, E. and Peirce, A.P. 2000. "Numerical stability properties of elastodynamic direct boundary element methods." proc: 14th Engineering Mechanics Conf. (ed: Tassoulas) (EM2000), Univ. of Texas at Austin, May 21-24.

Desroches, J., Gu, H., Siebrits, E. and Peirce, A. 1999. "On the influence of the contrast of elastic properties on modeling hydraulic fractures." presentation: Latest advances in hydraulic fracturing: workshop in memory of Jacob Shlyapoobersky. 37th U.S. Rock Mech. Symp. Vail. 5-6 June 1999.

Siebrits, E. 1995. "The stability properties of time domain elastodynamic boundary element methods," double invited speaker at 17th Boundary Element Conf. (BEM17). Madison. 17-19 July 1995.

Siebrits, E. and Daehnke, A. 1995. "Elastodynamics and rockburst back analysis." seminar: Static and dynamic modelling of rockmass behavior. Kloof gold mine. Johannesburg. 1 March 1995.

Siebrits, E. 1994. "Stresses and displacements induced by mining tabular deposits." course: Chamber of Mines Red Ticket. CSIR Mining Technology Division. Johannesburg. June 1994.

Siebrits, E. 1994. "Elastodynamics: past, present and future." seminar: Static and dynamic modelling of rockmass behavior. Kloof gold mine. Johannesburg. 24 February 1994.

Siebrits, E. 1990. "Elastodynamic rockmass modelling using a displacement discontinuity method." seminar: Development and application of numerical models of the fractured rockmass surrounding deep excavations. Johannesburg. 5-6 Sept. 1990.

Siebrits, E. and Pearce, H.T. 1986. "Three-dimensional elastodynamic fracture propagation and ground motion simulation model." conf. proc: Finite element methods in South Africa (FEMSA). University of Cape Town.

Publications:

Siebrits, E. and Peirce, A.P. 2002. "An efficient multi-layer planar 3D fracture growth algorithm using a fixed mesh approach." Int. J. Num. Meth. Engrg. 53. 691-717.

Smith, M.B., Bale, A.B., Britt, L.K., Klein, H.H., Siebrits, E. and Dang, X. 2001. "Layered modulus effects on fracture propagation, proppant placement, and fracture modeling." paper SPE 71654.

Peirce, A.P. and Siebrits, E. 2001. "The scaled flexibility matrix method for the efficient solution of boundary value problems in 2D and 3D layered elastic media." Computer Meth. Appl. Mech. Engrg. 190(45). 5935-5956.

Peirce, A.P. and Siebrits, E. 2001. "Uniform asymptotic approximations for accurate modeling of cracks in layered elastic media." Int. J. of Fracture. 110. 205-239.

Siebrits, E. and Elbel, J. 2001. "Refracture reorientation enhances gas production from tight gas wells." GTI GasTIPS. Summer 2001. 7(2). 28-31.

Siebrits, E., Elbel, J.L., Hoover, R.S., Diyashev, I.R., Griffin, L.G., Demetrius, S.L., Wright, C.A., Davidson, B.M., Steinsberger, N.P. and Hill, D.G. 2001. "Refracture reorientation enhances gas production." JPT. April. 61-62.

Siebrits, E., Elbel, J.L., Hoover, R.S., Diyashev, I.R., Griffin, L.G., Demetrius, S.L., Wright, C.A., Davidson, B.M., Steinsberger, N.P. and Hill, D.G. 2000. "Refracture reorientation enhances gas production in Barnett shale tight gas wells." paper SPE 63030.

Birgisson, B., Siebrits, E. and Peirce, A.P. 1999. "Elastodynamic direct boundary element methods with enhanced stability properties." Int. J. Num. Meth. Engrg. 46. 871-888.

Siebrits, E., Elbel, J.L., Detournay, E., Detournay-Piette, C., Christianson, M., Robinson, B.M. Diyashev, I.R. 1998. "Parameters affecting azimuth and length of a secondary fracture during a refracture treatment." paper SPE 48928.

Peirce, A. and Siebrits, E. 1997. "Stability analysis and design of time stepping schemes for general elastodynamic boundary element methods." Int. J. Num. Meth. Engrg. 40.

319-342.

Shou, K-J., Siebrits, E. and Crouch, S.L. 1997. "A higher order displacement discontinuity method for three-dimensional elastostatics problems." Int. J. Rock Mech. Min. Sci. 34(2). 317-322.

Siebrits, E. and Peirce, A.P. 1997. "Implementation and application of elastodynamic boundary element discretizations with improved stability properties." Int. J. Computer Aided Engrg and Software. 14(6). 669-695.

Siebrits, E., Peirce, A.P., Birgisson, B., Crouch, S.L. and Napier, J.A.L. 1997. "On the numerical stability of time domain boundary element methods." Int. Q. J. Blasting & Frag. 1(2). 305-316.

Siebrits, E., Smit, J.L., Ruther, H., and Malan, F. 1997. "The mapping of blast-induced deformations in deep gold mines by digital photogrammetry." Int. Q. J. Blasting & Frag. 1(2). 233-242.

Peirce, A. and Siebrits, E. 1996. "Stability analysis of model problems for elastodynamic boundary element discretizations." Num. Meth. for Partial Diff. Eqns. 12. 585-613.

Smit, J.L., Ruther, H. and Siebrits, E. 1996. "The 3D mapping of a textured surface using digital photogrammetric techniques." Int. Arch. of Photogrammetry and Remote Sensing. 31(B4). 728-733.

Napier, J.A.L. and Siebrits, E. 1995. "Enhanced boundary element simulation of three-dimensional fracture interaction." Proc.: BEM17 (eds: Brebbia, Kim, Osswald & Power). 367-374. Southampton: Computational Mech. Publ.

Siebrits, E., Daehnke, A. and Hildyard, M.W. 1995. "Experimental and numerical modelling of dynamic stope-wave interactions." proc: SAIMM SIMRAC Symp. 1 Sept. 1995. pp. 11.

Siebrits, E. and Peirce, A. 1995. "Stability properties of time domain elastodynamic boundary element methods." proc.: BEM17. (eds: Brebbia, Kim, Osswald & Power). 45-57. Southampton: Computational Mech. Publications.

Siebrits, E. and Crouch, S.L. 1994. "Two-dimensional elastodynamic displacement discontinuity method." Int. J. Num. Meth. Engrg. 37. 3229-50.

Siebrits, E., Hildyard, M.W. and Daehnke, A. 1994. "Elastodynamics: Past, present and future." proc.: ISRM SANGORM Symp. on 'Applications of Numerical Modelling in Geotechnical Engineering.' Pretoria. 1 Sept. 1994. 9-12.

Siebrits, E. and Crouch, S.L. 1993. "Geotechnical applications of a two-dimensional elastodynamic displacement discontinuity method." Proc: 34th U.S. Symp. on Rock

Mech. (ed: Haimson). Madison. 1. 133-136. and Int. J. Rock Mech. Sci. & Geomech. Abstr. 30(7). 1387-1393.

Siebrits, E., Hildyard, M.W. and Hemp, D.A. 1993. "Stability of backfilled stopes under dynamic excitation." 3rd Int. Symp. on Rockbursts and Seismicity in Mines. 16-18 August. Kingston. 117-121.

Siebrits, E., Tian, Y. and Crouch, S.L. 1992. "Two-dimensional elastodynamic boundary element methods with mining applications." Proc.: Boundary Elements XIV. (eds: Brebbia, Dominguez and Paris). Sevilla. Spain. vol. 2: Stress analysis and computational aspects. 91-105. Southampton: Computational Mech. Publ.

Technical Reports:

Rossmannith, H.P. "Crack stability at interfaces in connection with hydraulic fracturing." (ed: E. Siebrits), Schlumberger int. rep. DL 11189.

Siebrits, E. 1998. "New 2D multiple material model testing." Schlumberger Dowell, Inc. int. rep. DL 11074.

Napier, J.A.L., Hildyard, M.W., Kuijpers, J.S., Daehnke, A., Sellers, E.J., Malan, D.F., Siebrits, E., Ozbay, M.U., Dede, T. and Turner, P.A., "Develop a quantitative understanding of rockmass behavior near excavations in deep mines." Safety in Mines Research Advisory Committee (SIMRAC) Final Project Report. Project no. GAP029. Dec. 1995.

Peirce, A.P. and Siebrits, E. 1995. "The stability properties of time domain elastodynamic boundary element methods." CSIR. int. rep. RE5/95.

Siebrits, E., Daehnke, A. and Hildyard, M.W. 1995. "Rockburst back analysis." CSIR. int. rep. RE 6/95.

Siebrits, E. and Hildyard, M.W. 1993. "Comparison between dynamic codes FLAC, TWO4D and WAVE." CSIR. int. rep. RE 1/93.

Siebrits, E. and Crouch, S.L. 1992. "Compressional, shear, and surface wave interactions with tabular mining excavations." GeoLogic Research Inc. topical rep. R92/1.

Siebrits, E. 1991. "Three-dimensional elastodynamic displacement discontinuity method in transformed domain." Chamber of Mines Research Organization. int. note R5/91.

Siebrits, E. and Loken, M.C. 1991. "Analytical derivation of static and dynamic boundary element integrals." Chamber of Mines Research Organization. int. note R4/91.

Siebrits, E. 1990. "A constant strength three-dimensional elastodynamic displacement

discontinuity method." Chamber of Mines Research Organization. int. note R3/91.

Siebrits, E. 1990. "Mining applications of the elastodynamic displacement discontinuity method." Chamber of Mines Research Organization. Int. note R17/90.

Siebrits, E. and Napier, J.A.L. 1989. "Linear variation displacement discontinuity method to model parallel cracks using iterative solution algorithms." Chamber of Mines Research Organization. Rock Mechanics Laboratory. int. rep. 570.

Siebrits, E. 1988. "Principles of an elastodynamic displacement discontinuity method to model automatic planar fault rupture." Chamber of Mines Research Organization. Rock Mechanics Laboratory. res. rep. 8/88.

Siebrits, E. 1987. "Three-dimensional elastodynamic shear fracture propagation and ground motion simulation model." Chamber of Mines Research Organization. Rock Mechanics Laboratory. int. rep. 409.